

# Pioneer Mission Support

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*Status of the current Pioneer missions and initial operations planning for the Pioneer Venus Mission is given.*

## I. Pioneers 6, 7, 8, and 9

None of these spacecraft has been tracked during the last six months. Coverage is expected to continue at an extremely low level of support, although some tracking of Pioneers 6 and 9 will occur in October and November in support of radial alignments with the Helios spacecraft. The status of the spacecraft when each was last tracked was as follows:

All Pioneer 6 spacecraft systems were operating normally except for the failure of receiver 2 (which has restricted uplink to the low-gain antenna only), degradation of the solar array output and attitude-control sun sensors due to ultraviolet (UV) radiation and particulate impacts, and depletion of the attitude control gas supply. All instruments were also operating normally, except for the magnetometer and the radio propagation experiment. The magnetometer had failed in 1971, and the propagation instrument had been powered down due to the decommissioning of the experimenter's transmitting antenna at Stanford University.

Pioneer 7 was operating at reduced power due to severe degradation of the solar array. Transmitter (TWT) 1 and the roll index sun sensor were nonoperational and

the performance of the attitude-control sun sensors was degraded. All other spacecraft systems were operational. The power limitation primarily affects the instruments, all of which are powered down. Only the plasma analyzer will be turned on when the spacecraft is next tracked.

Pioneer 8 was operating normally except for some degradation in solar array output and degradation in performance of the attitude-control sun sensors. Except for the cosmic dust and cosmic ray detectors, all instruments were operational. Although no data are being returned from the radio propagation experiment, the instrument remains on so that it may provide power to the electric field detector.

All Pioneer 9 spacecraft systems and instruments were operating normally except for one failed command decoder address and the lack of data from the radio propagation experiment, as described above for Pioneer 8.

## II. Pioneers 10 and 11

### A. Mission Status and Operations

Both spacecraft continue to operate normally except for some degradation in the performance of the Pioneer 10

star sensor and the failure of the Pioneer 11 spin-down thruster. The majority of instruments on board Pioneer 10 are operating normally, exceptions being the asteroid/meteoroid detector (powered down), the cosmic ray telescope (some radiation damage experienced at Jovian encounter), the infrared radiometer (powered down, no data in cruise phase), and the magnetometer (failed in November of 1975). Approximately half of the cells of the meteoroid detector have been punctured to date. The majority of the Pioneer 11 instruments are also operating normally. Exceptions are the asteroid/meteoroid detector (powered down in June of 1975 as the suspected cause of uncommanded spacecraft status changes), the imaging photopolarimeter (has some stepping problems at cone angles greater than 150 deg, but can be compensated for), the infrared radiometer (activated only once every eight months for checkout), the flux gate magnetometer (activated only once every two months for checkout) and the plasma analyzer (no output since April of 1975).

Tracking support of these spacecraft has been severely limited recently due to other commitments by the Deep Space Network. However, it has been possible to provide an average of one track per spacecraft per day to allow for monitoring of spacecraft health and acquiring scientific data. The majority of this coverage has been provided by the 26-meter stations, most notably those equipped with the 3-hertz tracking loop filters previously discussed in Ref. 1. The performance enhancement affected by these filters will allow recovery of Pioneer 10 telemetry at 16 bits per second until early 1977, when the spacecraft range will be approximately 11.5 AU. Since the Pioneer 11 Saturn encounter in September of 1979 will occur at a range of approximately 10.3 AU, the use of these filters will allow some off-loading of the 64-meter subnet during the pre-Saturn encounter period when Pioneer 11 will be competing for coverage with Pioneer Venus and the Jupiter encounters of the Mariner Jupiter-Saturn (MJS) mission.

## **B. Jovian Magnetic Tail Penetration**

Pioneer 10 passed through the magnetic tail of Jupiter in March of this year, although the spacecraft was more than 4 AU from the planet (Fig. 1). The streaming out of the planet's magnetosphere into a tail-like shape due to the incident solar wind is a well-known phenomenon (Pioneer 7 observed Earth's magnetic tail in 1967) and it was anticipated that the Jovian tail would be detectable at a great distance because of the planet's extensive magnetosphere. Nevertheless, it was somewhat surprising to find that the tail extended almost 700 million kilometers from the planet.

The spacecraft crossed the orbit of Saturn in early February. By mid-March, when penetration occurred, it was slightly off the Sun-Jupiter line and 6 deg above the Jovian orbital plane. Although the exact period of immersion could not be determined because of non-continuous tracking coverage, the spacecraft was in the tail for at least 24 hours. For that interval, the plasma analyzer instrument observed no evidence of a solar wind, indicating that the wind had been blocked by the planet's magnetic field. The spacecraft magnetometer, having failed after the Jovian encounter, could not provide a measure of the change in magnetic field strength from interplanetary levels.

The extent of Jupiter's magnetic tail implies that Saturn should enter the tail every 20 years. If so, this will next occur in April of 1981 and may be observable by the MJS spacecraft.

## **C. Future Support**

In all probability, coverage of the Pioneer 10 and 11 missions will continue at the current levels for the foreseeable future. Availability of the 64-meter stations should improve shortly before Pioneer 10 thresholds on the 26-meter subnets. However, available tracking time will be limited due to support of other ongoing and extended missions as well as by the lengthy periods of down-time required for implementation of the Mark III Data System.

One bright spot is the pending upgrade in late 1978 of the DSS 12 antenna at Goldstone to a diameter of 34 meters. The anticipated 2.2-dB gain improvement will considerably extend this station's ability to support Pioneer 11.

Possible improvements at the 64-meter stations were discussed in Ref. 1, and these will be especially significant for Pioneer 11, which may penetrate the heliospheric bow shock prior to exceeding the limits of communications with Earth. As shown in Fig. 2, the heliosphere is distended by the interstellar wind in much the same way that the solar wind causes the magnetospheres of Earth and Jupiter to be distorted. Although the bow shock's exact location cannot be determined until the spacecraft crosses it, it is of great scientific interest to know where the Sun's influence ends and interstellar space truly begins.

## **III. Pioneer Venus**

Initial operations planning has begun for these missions, which are to be launched in 1978. The most significant

operational problem area yet determined is the optimal method of supporting the multiprobe entry. The tentative station configuration for this phase of the mission has been presented elsewhere (Ref. 2), but a number of questions remain open; namely, which receivers should be operated from the Station Monitor and Control Console and which by individual operators, what is the optimal physical

location for the extra receivers and their operators, and what options exist for failure mode recovery? The answers to these and related questions are being actively sought in the detailed formulation of the operations plan for the multiprobe entry. Future Progress Report articles in this series will report on progress as the Mission and DSN operations plans are developed.

## References

1. Miller, R. B., "Pioneer 10 and 11 Mission Support," in *The Deep Space Network Progress Report 42-33*, pp. 21-25, Jet Propulsion Laboratory, Pasadena, California, June 15, 1976.
2. Miller, R. B., "Pioneer Venus 1978 Mission Support," in *The Deep Space Network Progress Report 42-27*, pp. 28-35, Jet Propulsion Laboratory, Pasadena, California, June 15, 1975.

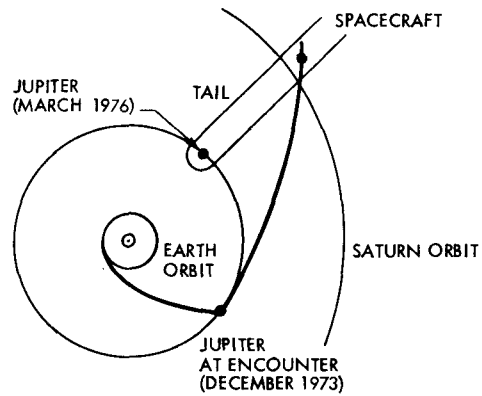


Fig. 1. Magnetic tail penetration geometry

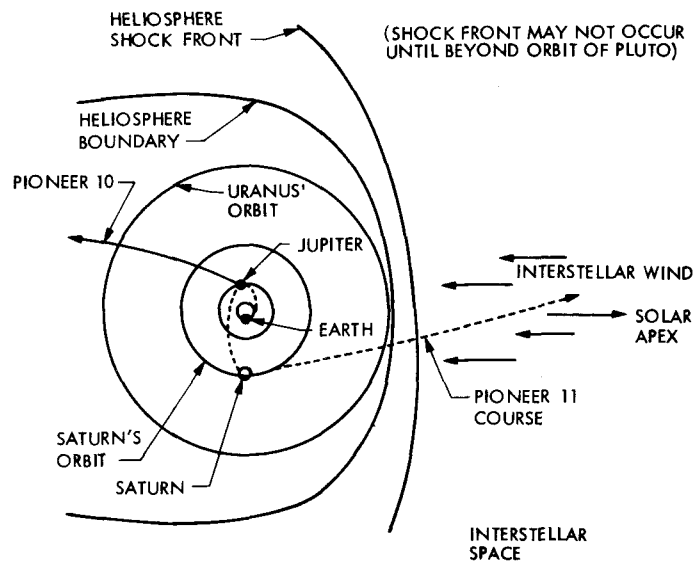


Fig. 2. Pioneer 11 enters interstellar space